TRANSPORTATION AND THE CITY
A DUTCH PERSPECTIVE ANNO 1970

Report: the moving and resting car

The attractive power of the city and the attractiveness of the car

The attractors in a city: a pre-GIS view

Source: ANWB 1970
DEVELOPMENTS IN THE NETHERLANDS 1978-2018
GROWTH IN POPULATION SIZE AND PERSON MOBILITY (KM)

Dutch population
Index 1978 = 100

* excluding air traffic

Source: CBS, StatLine
MODAL SPLIT
MOBILITY DUTCH POPULATION (2014)

trips
- car driver: 32%
- car passenger: 21%
- bicycle: 15%
- train: 15%
- bus, tram, metro: 9%
- other: 2%

kilometers
- car driver: 50%
- car passenger: 9%
- bicycle: 7%
- train: 3%
- bus, tram, metro: 9%
- other: 22%

Source: KIM, 2018
DECOMPOSITION OF MOBILITY GROWTH IN NL

- Population size is an important factor, but can only explain part of the mobility growth in the Netherlands

- However, other demographic factors contribute as well:
  - thinning of households (52% growth of # households)
  - aging of the population

Source: CBS 2017
ECONOMY CONTRIBUTES TO MOBILITY GROWTH

Although the Netherlands faced some periods of economic recession, from 1978 to 2018 there has been substantial economic growth, net household incomes have increased considerably enabling an increase in vehicle ownership and travel expenditures.

E.g. car ownership increased from 269 cars (1978) to 481 cars (2018) per 1000 inhabitants.
Our country started as one of the first in the world with the design and construction of a coherent motorway network.

Now it has the most dense motorway network in the EU: 73 km motorway per 1000 km² (or 144 km per 1 million inhabitants)
SPATIAL PLANNING (2)

NATIONAL URBANIZATION POLICY ("GROEIKERNELENBELEID")
In transport planning the “law of a constant travel time budget” is well known (although also widely debated): it says that on average an individual of any society spends a fixed amount of time per day on travelling.

The combination of main road infrastructure development and the national urbanization policy allowed people to travel faster enabling them to travel longer distances within the same travel time budget and to live further away from work locations.
There have been and still are many other factors contributing to mobility developments, a.o.:

- human behavior
- E-society
- pricing and taxation policies
- intelligent transport systems (ITS) and traffic management
- parking policies
- green transport services (transit and active transport)
- MaaS (Mobility as a Service)
CONCLUSIONS FROM RESEARCH (1)

- Many factors are intertwined, since travel demand is a derived demand. People travel because they have a need or a wish to participate in activities, that can be done at locations distributed over and sometimes clustered in space.
- Impacts of separate factors are difficult, if not impossible to assess.
- The main drivers of mobility growth are:
  - Demographics
  - Economy
  - Spatial Planning
  - Human Behavior
Urban mobility growth in NL has been moderate, compared to national mobility growth.

Explanations:
- Size and compactness of cities
- Transit oriented development
- Investments in bicycle infrastructure and facilities
- Modal integration
- Car policies (car-free zones, parking policies, road hierarchy)
- Cultural traditions
RESEARCH IN TRANSPORT PLANNING TOOLS

Case study: Enschede

Desire lines

Assignment

Source: ANWB, 1970
# TRANSPORT PLANNING
## HISTORY OF MODELLING TECHNIQUES

<table>
<thead>
<tr>
<th>Decade</th>
<th>Technique</th>
</tr>
</thead>
<tbody>
<tr>
<td>60's</td>
<td>Aggregate modelling (extrapolation)</td>
</tr>
<tr>
<td>70's</td>
<td>Disaggregate modelling (choice behaviour)</td>
</tr>
<tr>
<td>80's</td>
<td>Scenario analysis / Statistical uncertainty</td>
</tr>
<tr>
<td></td>
<td>Spatial scale diversification</td>
</tr>
<tr>
<td></td>
<td>Macro-simulation models (dynamics, corridor)</td>
</tr>
<tr>
<td>90's</td>
<td>Micro-simulation models (dynamics, local scale)</td>
</tr>
<tr>
<td></td>
<td>Activity-based modelling</td>
</tr>
<tr>
<td></td>
<td>LUTI modelling (LUTI = Land use transport interactions)</td>
</tr>
<tr>
<td>00's</td>
<td>Accessibility modelling / strategic models / GIS</td>
</tr>
<tr>
<td></td>
<td>Micro-simulation (dynamics, network scale)</td>
</tr>
<tr>
<td>10's</td>
<td>LUTI modelling (cellular automata, agent based modelling, remote sensing)</td>
</tr>
<tr>
<td></td>
<td>Big data analysis</td>
</tr>
</tbody>
</table>

**ITC**

**UNIVERSITY OF TWENTE.**
The world we live in …

GLOBAL TRENDS: RAPID URBANIZATION

World population will increase from 7 billion today to more than 9 billion in 2050.

That translates into an average 1 million more city dwellers every week for the next 38 years.

These trends are impossible to stop, so the question is not whether or not urbanization should take place, but how best to urbanize.

Source: Planet under pressure, 2012
IMPACTS OF URBANIZATION

URBANIZATION AND ECONOMIC GROWTH ARE INEXTRICABLY LINKED

Kenya - Economic Growth and Urbanization

Brazil - Economic Growth and Urbanization

India - Economic Growth and Urbanization

Source: UNDESA, 2007
IMPACTS OF URBANIZATION

Urban sprawl

Environmental degradation

Severe accessibility problems

Poor living conditions
The world we live in …

GLOBAL TRENDS: RAPID MOTORIZATION

Rapid increase in car ownership and use (timing and rate of change differs).

Extensive expansion of (urban) road networks, thereby supporting suburbanization.

Marginalization of alternative modes of transport.

Urban divide in transport opportunities.

Source: Planet under pressure, 2012
### Historical trend of worldwide vehicle registrations 1960-2010 (thousands)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Car registrations(^{(1)})</td>
<td>98,305</td>
<td>193,479</td>
<td>320,390</td>
<td>444,900</td>
<td>548,558</td>
<td>617,914</td>
<td>684,570</td>
<td>707,764</td>
</tr>
<tr>
<td>Truck and bus registrations</td>
<td>28,583</td>
<td>52,899</td>
<td>90,592</td>
<td>138,082</td>
<td>203,272</td>
<td>245,798</td>
<td>295,115</td>
<td>307,497</td>
</tr>
<tr>
<td>World total</td>
<td>126,888</td>
<td>246,378</td>
<td>410,982</td>
<td>582,982</td>
<td>751,830</td>
<td>863,712</td>
<td>979,685</td>
<td>1,015,261</td>
</tr>
</tbody>
</table>

Note (1) Cars registrations do not include U.S. light trucks (SUVs, minivan and pickups) that are used for personal travel. These vehicles are accounted among trucks.

### Comparison of motorization rates by region 1999 and 2009 (vehicles per 1000 people)

<table>
<thead>
<tr>
<th>Country/Region</th>
<th>1999</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>20.9</td>
<td>24.9</td>
</tr>
<tr>
<td>Asia, Far East</td>
<td>39.1</td>
<td>157.7</td>
</tr>
<tr>
<td>Asia, Middle East</td>
<td>66.2</td>
<td>101.2</td>
</tr>
<tr>
<td>Canada</td>
<td>560.0</td>
<td>620.9</td>
</tr>
<tr>
<td>Central and South America</td>
<td>133.6</td>
<td>169.7</td>
</tr>
<tr>
<td>Europe, East</td>
<td>370.0</td>
<td>363.9</td>
</tr>
<tr>
<td>Europe, West</td>
<td>528.8</td>
<td>583.3</td>
</tr>
<tr>
<td>Pacific</td>
<td>513.9</td>
<td>560.9</td>
</tr>
<tr>
<td>United States</td>
<td>790.07</td>
<td>828.04</td>
</tr>
</tbody>
</table>


Source: Automobile and Truck Trends, 2011
IMPACTS OF MOTORIZATION

Congestion

Emissions (climate change, pollution, noise)

Traffic casualties

Fragmentation (barriers, road space)

Degradation of livability in cities

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PARADIGM SHIFT IN INTEGRATED URBAN PLANNING

Car/vehicle-oriented approach (current)

People-oriented approach (proposed)
RESEARCH PROGRAM
PEOPLE, LAND AND URBAN SYSTEMS (PLUS)

Stakeholders

Geo-information technology

space

time

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RESEARCH FOCUS

- Urban planning
  - Compact cities
  - Competitive cities
  - Inclusive cities
  - Resilient cities

- People
  - Attitudes
  - Perceptions
  - Behavior
  - Engagement
INTEGRATED PLANNING
PLANNING, LAND DEVELOPMENT AND ACCESSIBILITY

Case study: Wuhan, China

INTEGRATED PLANNING

TRANSIT ORIENTED DEVELOPMENT INDEX

Design case study: Arnhem/Nijmegen region

Table 1
Criteria for measuring Potential TOD Index.

<table>
<thead>
<tr>
<th>Potential TOD Index</th>
<th>Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Criteria</td>
<td></td>
</tr>
<tr>
<td>What are the various densities?</td>
<td>Residential density</td>
</tr>
<tr>
<td></td>
<td>Employment density</td>
</tr>
<tr>
<td></td>
<td>Commercial intensity/density</td>
</tr>
<tr>
<td>How diverse is the land use?</td>
<td>Land use diversity</td>
</tr>
<tr>
<td>Does the design of urban space encourage walking and cycling?</td>
<td>Level of mixed-use of land uses w.r.t residential land use</td>
</tr>
<tr>
<td></td>
<td>Quality and suitability of streetscape for walking</td>
</tr>
<tr>
<td></td>
<td>Quality and suitability of streetscape for cycling</td>
</tr>
<tr>
<td></td>
<td>Density of controlled intersections/ street crossings</td>
</tr>
<tr>
<td>What is the current level of economic development?</td>
<td>Private investment in the area</td>
</tr>
<tr>
<td></td>
<td>Number of business establishments</td>
</tr>
<tr>
<td></td>
<td>Tax earnings of municipality</td>
</tr>
<tr>
<td></td>
<td>Unemployment levels</td>
</tr>
</tbody>
</table>

INTEGRATED PLANNING
LAND USE TRANSPORT INTERACTION MODELLING

Case study:
Jeddah, Saudi Arabia

Cellular automata

Transport infrastructure

Residential Area Growth

Source: Aljoufie, Zuidgeest, Brussel, van Vliet and van Maarseveen (2013)
A cellular automata-based land use and transport interaction model applied to Jeddah, Saudi Arabia. In: Landscape and Urban Planning
INTEGRATED PLANNING
ACCESSIBILITY ASSESSMENT URBAN POOR

Urban poor
- Income
- Education level

Physical condition of housing

Transport options
- Modes
- Networks

Employment
- Location of jobs
- Job type

Case study:
Ahmedabad, India

Source: Beukes, Vanderschuren, Zuidgeest, Brussel and van Maarseveen (2013) Quantifying the contextual influences on road design. In: Computer-Aided Civil and Infrastructure Engineering
INFRASTRUCTURE PLANNING
CYCLING POTENTIAL FOR MODAL INTEGRATION

Focus group
In depth interviews
PT users (potential bike & ride users)
Questionnaire
Experts group

PT users (potential bike & ride users)
Train station and bus stops (Santa Cruz)
Intercept interview
Sample with desired profile

PT users (with desired profile)
Telephone interview
Final database

Private bike parking (Santa Cruz)
Metro Station (Colegio)

Metro station (Colegio)

Access modal share per neighbourhood

Source: Carvalho de Souza, La Paix Puello, Brussel, Orrico and van Maarseveen (2017) Modelling the potential for cycling in access trips to bus, train and metro in Rio de Janeiro. In: Transportation Research Part D: Transport and Environment
# Infrastructure Planning

## Equitable Distribution of Infrastructures

### Integrated Infrastructure

<table>
<thead>
<tr>
<th>Input</th>
<th>Process</th>
<th>Output</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household/</td>
<td>Domestic activity</td>
<td>Income generating/</td>
<td>Development activity</td>
</tr>
<tr>
<td>Domestic activity</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Outcome

**Integrated in terms of:**
- INPUT
- PROCESS
- OUTPUT
- IMPACT

The OUTCOME of integrated infrastructure in the context of community development: Providing opportunities to economic activities

<table>
<thead>
<tr>
<th>Water</th>
<th>Debit</th>
<th>m³/year/household</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
<td>Supply capacity</td>
<td>Kwh/household</td>
</tr>
<tr>
<td>Transport</td>
<td>Transportation cost</td>
<td>Rp/km</td>
</tr>
<tr>
<td>Communication</td>
<td>Bandwidth</td>
<td>kbps</td>
</tr>
</tbody>
</table>

### Fuzzy Logic:

Example:
- 80% truth of cold
- 20% truth of warm
- 0% truth of hot

### Case Study:

Yogyakarta, Indonesia

The maps show level of opportunity for economic activities (3 classes with value of truth between 0 – 1)

Unit of analysis: Village (level of opportunity for economic activities in the village)

HUMAN BEHAVIOR
ATTITUDES, MOTIVATORS AND BARRIERS

Case study:
Dar-es-Salaam, Tanzania

Table 1
Stages of change in Prochaska and DiClemente’s (1984) transectional model.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Characteristics</th>
<th>Change strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-contemplation</td>
<td>Unaware of problems,</td>
<td>Increase general</td>
</tr>
<tr>
<td></td>
<td>no intention to change</td>
<td>problem awareness</td>
</tr>
<tr>
<td>Contemplation</td>
<td>Aware of problems,</td>
<td>Motivate, encourage</td>
</tr>
<tr>
<td></td>
<td>thinking about change</td>
<td>specific action</td>
</tr>
<tr>
<td>Prepared for action</td>
<td>Intention to change</td>
<td>Assist in developing</td>
</tr>
<tr>
<td></td>
<td>in the next six months</td>
<td>specific plans</td>
</tr>
<tr>
<td>Action</td>
<td>Action being taken</td>
<td>Feedback, social support,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>reinforcement</td>
</tr>
<tr>
<td>Maintenance</td>
<td>Has maintained action</td>
<td>Reminders, feedback,</td>
</tr>
<tr>
<td></td>
<td>for six months or more</td>
<td>social support</td>
</tr>
</tbody>
</table>

Cluster analysis, based on the networks of individuals:

- Easy riders
- ‘I’ generation
- Well connected
- Popular people
- Digitally inclined

HUMAN BEHAVIOR
BUILT ENVIRONMENT AND OLDER ADULTS’ WALKING

Case study:
Birmingham, England

POLICY ORIENTATION
CLIMATE VALUE OF CYCLING

Case study:
Bogotá, Colombia

Climate Value of Cycling for Bogotá: annually 41,663 tCO₂

POLICY ORIENTATION
TRANSITION TO LOW-CARBON TRANSPORT

ASEAN Strategic Transport Plan
2011-2015

FINAL REPORT

A-S-I APPROACH

<table>
<thead>
<tr>
<th>AVOID / REDUCE</th>
<th>SHIFT / MAINTAIN</th>
<th>IMPROVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce or avoid the need to travel</td>
<td>Shift to or maintain share of more environmentally friendly modes</td>
<td>Improve the energy efficiency of transport modes and vehicle technology</td>
</tr>
</tbody>
</table>

System Efficiency
Trip Efficiency
Vehicle Efficiency

Flagship Programs, 31
Institutional Strengthening, 6
SME Development Cluster, 4
Natural Resources, 6
Joint Tourism, 11
Transport, Infrastructure and ICT, 7
Monitoring and Evaluation, 3

Source: Bakker, Contreras, Kappiantari, Tuan, Guillen, Gunthawong, Zuideest, Liefferink, and van Maarseveen (2017) Low-Carbon Transport Policy in Four ASEAN Countries: Developments in Indonesia, the Philippines, Thailand and Vietnam. In: Sustainability
METHODOLOGICAL RESEARCH

BIG DATA OF A PUBLIC BIKE SYSTEM

Case study: Zhongshan, China

METHODOLOGICAL RESEARCH
DETECTION OF DEPRIVED URBAN AREAS

ISS night light image Dar-es-Salaam

Average night lights within deprived areas

Distance from city centre in km

Georeferencing Belo Horizonte

Case studies: Mumbai, Ahmedabad, Belo Horizonte, Dar-es-Salaam

Source: Kuffer, Pfeffer, Sliuzas, Taubenböck, Baud and van Maarseveen (2018)
METHODOLOGICAL RESEARCH
INTEGRATION OF PLANNING AND PUBLIC HEALTH

Case studies: Dortmund & Munich, Germany

Source: Shrestha, Köckler, Flacke, Martinez and van Maarseveen (2017) Interactive Knowledge Co-Production and Integration for Healthy Urban Development. In: Sustainability
Geo-information technology and tools can make a difference in integrated and participatory spatial planning of cities around the world, by co-creation of explicit knowledge and raising awareness and support if and only if these are adapted to the local context and address the needs of the local community.
PhD Graduates
Thank You!